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Opportunity for Natural Selection in Relation to Socioeconomic Factors among the Kom Tribe of Manipur

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Abstract

This paper describes the opportunity of natural selection in relation to age at marriage and household income among the Kom tribe of Churachandpur District in Manipur. A total number of 235 of mothers aged 40 years and above were included in the sample for computing the indices of the opportunity for natural selection according to Crow's formula and its modified version by Johnston and Kensinger. It is found that the total index of opportunity for natural selection is low when compared with other populations. The index of opportunity for natural selection due to differential fertility was greater than that due to differential mortality. It was also found that the total index of opportunity for natural selection was negatively associated with age at marriage and income level of the households. It is suggested that the operation of natural selection in contemporary populations is declining due to cultural development such as changes in socioeconomic conditions and technology, particularly in the fields of medical sciences.

Keywords: Natural Selection Intensity; Fertility; Mortality; Socioeconomic Conditions.

Introduction

Natural selection occurs when individuals of the different genotypes in a population are different from one another in their fitness know as Darwinian fitness, or genetic fitness. Darwinian fitness is defined as the "reproductive capability of an individual or class of individuals, in terms of the number of offspring they contributed to the next generation" [16]. It is well known that demographic variables, like fertility and mortality are the fundamental events of natural selection. In fact, from the demographic point of view, "differences in rates of reaching maturity, mating, fecundity, fertility, mortality and emigration are the raw materials of natural selection" [31].

Several studies have shown that natural selection is operating through differential fertility and mortality. Crow [5] proposed an index which is known as index of total selection intensity (now called the index of opportunity for selection) in terms of differential fertility and differential mortality. The method was modified by Johnston and Kensinger [14] by taking into consideration the embryonic deaths as well. Both the methods have been widely used by anthropologists and population geneticists to estimate the intensity of natural selection in human populations [24]. However, the methods failed to delineate the types of selection (whether it is stabilising, or directional, or disruptive). The methods simply assume that some phenotypic variation in reproduction has a genetic basis and fitness is heritable [31]. That is, the methods ignore the role of socio economic factors in bringing about Darwinian fitness. However, many studies have revealed that

the indices of the opportunity for selection, calculated according to the methods by Crow [5] and its modified version, [16] seemed to be negatively associated with socio-economic development [12, 24, 17-28]. Several works has been done on the selection intensity of human populations throughout the world including India and have noted variation of selection with regards to economic conditions, [10 3-29] cultural practices, [15-21, 23-27, 30] education and social status, [8, 17, 24] and altitudes. [7-13, 17]. In view of the above backdrop, we may hypothesize that indices of opportunity for selection are indicators of socioeconomic development. The main objective of this study is to estimate the indices of the opportunity for selection in relation to age at marriage of the mothers and household income among the Kom population of Churachandpur District in Manipur.

Materials and Methods

As far as the study is concerned, the present study was conducted in seven Kom villages of Churachandpur District in Manipur. A total number of 235 ever married mothers who had completed their reproductive stage (generally aged 40 years and above) at the time of investigation are taken into consideration and were interviewed to get the relevant information for this study as well as for calculation of the indices. The entire demographic data were collected through in-depth interview using structured schedule for getting the required information, [22, 34, 35] which includes data on (a) individual and household records which include name, age, sex, marital status family members, birth order, place of birth, place of residence, religion, occupation, education, income and expenditure of the household, etc., (b) Reproductive records which include pregnancy history of each married women, present age of the mother, age at marriage, approximate age at each conception, age at menopause, total number of live births, birth order, name, age, sex, marital status of each children, number of death children, sex, date of birth, age at death, cause of death, number of reproductive wastage (spontaneous and induced abortion, stillbirths) etc.

The formulae proposed by Crow [5] and its modified version by Johnston and Kensinger [14], were used for estimating the index of selection intensity among the Kom Tribe of Churachandpur District in Manipur.

Results and Discussion

Table 1 shows that there are 235 mothers who have completed their reproductive age (aged 40 years and above). The average number of live births to such mothers was found to be 3.03 with the corresponding variance of 1.977. The proportion of child mortality before reaching the reproductive age and the proportion of embryonic death was 0.019 and 0.041 respectively.

Table 1: Parameters used in calculating selection intensity

Total mothers who have completed their reproductive age (40 years and above)	235
Total number of pregnancies	751
Total number of Live-births	697
Number of death before 15 years of age	13
Number of embryonic deaths	31
Proportion of child death (death before 15 years) (P_d)	0.019
Proportion of embryonic death (P_{ed})	0.041
Average live birth per mother who have completed their reproductive age(x)	3.03
live births variance (V_f)	1.977

Table 2: Selection intensity indices of the Kom population with other population of Northeast

Population	According to Crow's (1958)			According to Johnston and Kensinger (1971)				
	I_m	I_f	I	I_{me}	I_{mc}	I_f	I	References
Kom	0.019	0.215	0.238	0.046	0.019	0.215	0.287	Present study
Khasis	0.198	0.158	0.387	0.012	0.198	0.158	0.403	Khongsdier (1990,1994)
Pnar	0.236	0.134	0.401	0.202	0.236	0.134	0.681	Khongsdier*et al*. (2001)
Marngars	0.133	0.231	0.395	0.043	0.133	0.231	0.455	Devi (2001)
Hajongs	0.443	0.131	0.631	0.032	0.443	0.131	0.684	Barua (1993)
Pnar of Nangbah village	0.055	0.141	0.241	0.024	0.055	0.141	0.266	Gangte (1993)

Table 2 shows the index of opportunity for selection calculated according to Crow's formula [5] and the modified methods suggested by Johnston and Kensinger [14] for the present population and other populations. It was found that the value of I, I_f and I_m calculated using Crow's formula [5] was 0.238, 0.215 and 0.019, respectively. On the other hand the value of I_{me}, I_{mc}, I_f and I calculated according to Johnston and Kensinger was 0.046, 0.019, 0.215 and 0.287 respectively. Thus it shows that the value (I) calculated according to Crows formula is lower than that calculated according to the method suggested by Johnston and Kensinger. This is due to the fact that in the case of Crow's formula, we have not taken into consideration the embryonic deaths (still-births and abortions) as in the case of Johnston and Kensinger's formula. However, considering both the methods, the index of selection due to fertility seems to contribute more towards selection than the index of selection due to mortality. In other words, the opportunity for natural selection in the present population seems to be operating more through differential fertility than differential mortality.

According to Khongsdier [20], the intensity of natural selection may be classified as low, moderate, mild, average, high and very high if the value of Crow's index of total selection intensity ranges from < 0.340; 0.340-0.470; 0.470-0.600; 0.600-0.730; 0.730-0.860; and > 0.860, respectively. Therefore, following this classification, it indicates that the opportunity for natural selection is moderately low in the present population.

In comparison with other populations as shown in Table 2, the total index of selection (I) according to Crow's [5] for the present population 0.238 is found to be similar to that of the Pnar of Nangbah village 0.241, but lower to than those reported for other populations in Northeast India. With respect to the index of selection due to fertility the present population 0.215 seems to be similar with the Marngars 0.231, but it is higher than other populations in Northeast India. Similarly, the index of selection due to mortality 0.019 is similar to that of the Pnar of Nangbah village 0.055 though it was lower than those reported for other populations in Northeast India.

Table 3: Estimated indices of selection intensity with income and age at marriage

Characteristics	No of mothers	According to Crow (1958)			According to Johnston and Kensinger			
		I_m	I_f	I	I_{me}	I_{mc}	I_f	I
Income group								
LIG	107	0.028	0.247	0.282	0.056	0.028	0.247	0.338
MIG	71	0.013	0.243	0.259	0.046	0.013	0.243	0.301
HIG	57	0.012	0.102	0.115	0.017	0.012	0.102	0.131
Age at marriage (yrs)								
≤ 19	124	0.011	0.224	0.236	0.053	0.011	0.224	0.306
≥ 20	111	0.019	0.110	0.131	0.031	0.019	0.110	0.161

*LIG- Low income group, MIG- Middle income group, HIG- High income group

Table 3 shows the indices of selection intensity according to mothers' age at marriage and household income. It is found that the total index of selection (I) calculated according to crow's [5] was higher in the LIG 0.282 as compared to MIG 0.259 and HIG 0.115. Similar trend was also found in the case of the index due to fertility (I_f) and mortality (I_m) which was higher in the LIG than in the higher income groups. Hence it is likely that the opportunity for natural selection is greater in the low income group than in the higher income groups.

In the case of the age at marriage of mothers, Table 3 shows that the total index selection intensity (I) for the mother whose age at marriage is = 19 years was higher than that for the mothers who were married at the of 20 years and above. The index of selection due to fertility (I_f) was also found to be higher among the mothers who were married early. But the index of selection due to mortality (I_m) was higher among the mothers who married at the age of 20 years and above. In general, it shows that the indices of opportunity for selection are negatively related to the mother's age at marriage.

Concluding Remarks

Natural selection is operating through differential survival and fertility of individuals due to differences in phenotype that reflect genetic differences [36]. Cavalli-Forza and Bodmer [4] reported that among agrarian and tribal societies, mortality contributes more towards selection rather than fertility. Until the mid-19th century, infant and child mortality was so high that the survivorship to age 15 years was around 50% even in countries presently considered to be developed [1-25]. Infectious diseases and

malnutrition were the two major causes of mortality [26,33]. This situation has changed drastically during the last 100 years or so with the advent of sanitation and medical treatments. The opportunity for natural selection through differential mortality has been considerably reduced at the end of the 20th century, and about 90% of live-births had an opportunity to fully participate in the reproduction of the next generation [1], while fertility became dependent on the conscious decisions of individuals and couples in both the sense of avoiding births and giving birth by infertile couples. Differential fertility contributed much less to the overall opportunity for selection since there was little genetic variation in this characteristic [4].

In India also, many studies conducted before 20 years ago indicated that mortality plays greater role in contributing more towards the process of opportunity for natural selection [24]. However, many studies during the last 20 years or so have indicated that the total index of opportunity for selection has decreased considerably. The reason for such changes is due to the decline in fertility and mortality rates, which are associated with socioeconomic conditions [29] and better access to public health amenities. This is also collaborated with the findings of the present study, which indicates that the overall index of opportunity for natural selection was higher in the lower economic groups of women and in those women with lower mean age at marriage.

Overall, the operation of natural selection on contemporary populations is declining due to cultural development such as advanced changes in technology, public health and increased food availability and modern medical practices, including antibiotics, vaccinations, treatment of high blood pressure, diabetes, heart disease and the management of reproductive health, but the magnitude of the decline may differ between populations due to different levels of sanitation, medical interventions and public health measures. It may, however, be noted that the relaxation of opportunity for natural selection may also be responsible for the increasing prevalence of many chronic diseases like type 1 diabetes [36] and other genetic disorders [32].

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